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Slogoff et al.

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(54) **STORAGE DEVICE WITH LOCKING MECHANISM**

(75) Inventors: **Shelly I. Slogoff**, Chester Springs, PA (US); **Robert R. King**, Elverson, PA (US)

(73) Assignee: **InterMetro Industries Corporation**, Wilkes-Barre, PA (US)

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A47B 88/20	(2006.01)
E05B 47/00	(2006.01)
E05B 47/02	(2006.01)
E05B 65/46	(2006.01)

(52) **U.S. Cl.**
CPC ***A47B 88/20*** (2013.01); ***E05B 47/0012*** (2013.01); ***E05B 47/023*** (2013.01); ***E05B 65/46*** (2013.01); *E05B 2047/0024* (2013.01)

(58) **Field of Classification Search**
CPC E05B 2047/0024; E05B 47/0012; E05B 47/023; E05B 65/46; A47B 88/20
USPC 312/215, 216, 222, 333
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,716,116 A	2/1998	Carlson et al.
5,803,559 A	9/1998	Carlson et al.
5,805,075 A	9/1998	Carlson et al.
5,940,306 A	8/1999	Gardner et al.

(Continued)

OTHER PUBLICATIONS

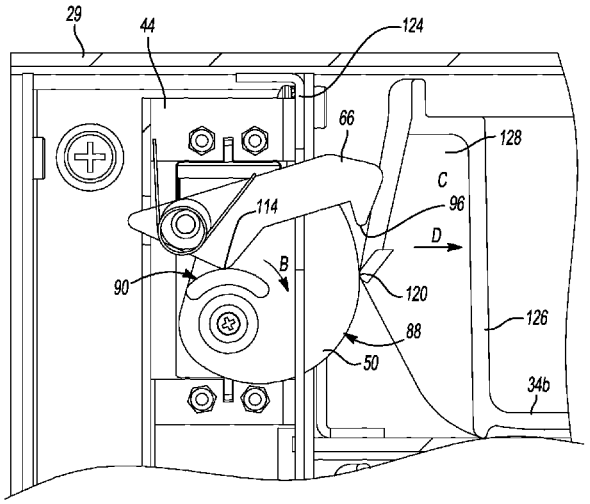
International Search Report and Written Opinion for PCT/US2011/062854, mailed Mar. 21, 2012; ISA/US.

Primary Examiner — Daniel J Troy
Assistant Examiner — Timothy M Ayres
(74) *Attorney, Agent, or Firm* — Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

A storage device having a locking mechanism includes a housing having a frame assembly. A storage device is movably received in the housing. An actuator is connected to the frame assembly, the actuator operating to move a cam member. A latch is connected to the frame assembly and is moved by contact with the cam member from a latched position preventing access to the storage device in the housing to an unlatched position permitting access to the storage device. An unlock-all mechanism operates to move the latch to the unlatched position without operation of the actuator.

20 Claims, 18 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

6,011,999	A *	1/2000	Holmes	700/231
6,158,830	A	12/2000	Johnson et al.	
6,511,138	B1	1/2003	Gardener et al.	
2001/0024039	A1 *	9/2001	Lippoldt et al.	292/197
2006/0220507	A1	10/2006	Steele et al.	
2007/0262084	A1	11/2007	Yuyama et al.	
2008/0278043	A1	11/2008	Holcomb	
2009/0212670	A1	8/2009	Bustle et al.	
2010/0114367	A1	5/2010	Barrett et al.	
2013/0320032	A1 *	12/2013	Rahilly	221/154
2014/0225491	A1 *	8/2014	Shoenfeld	312/237

* cited by examiner

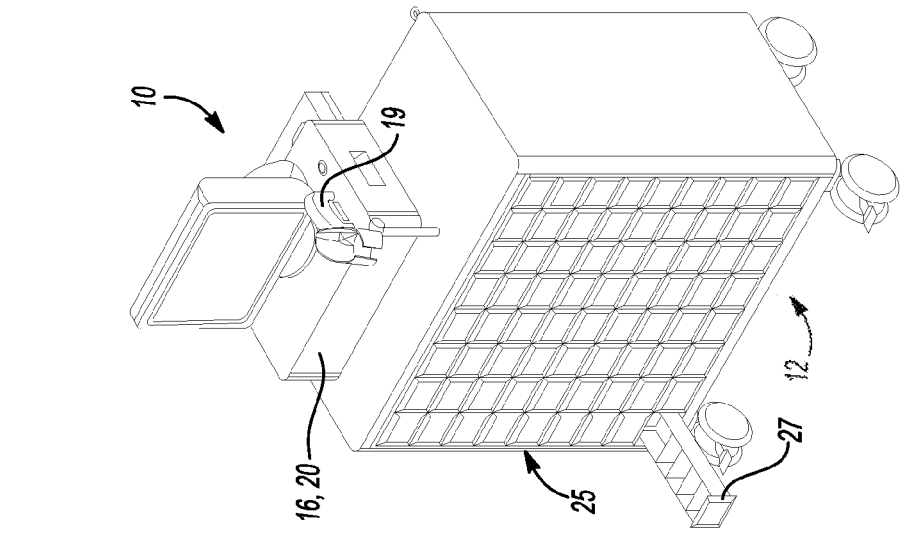


Fig-1C

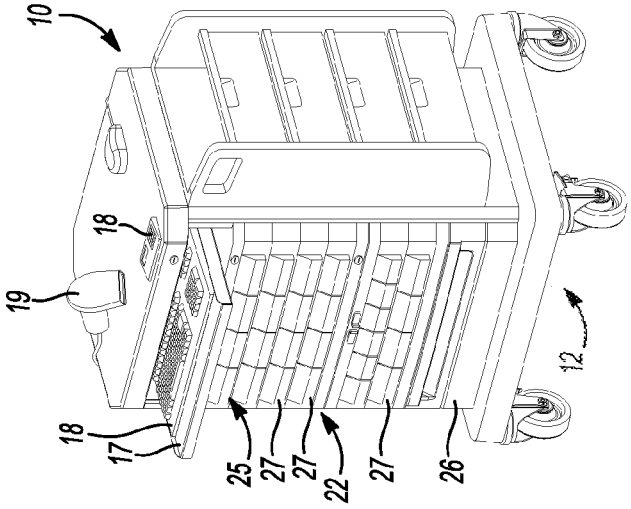


Fig-1B

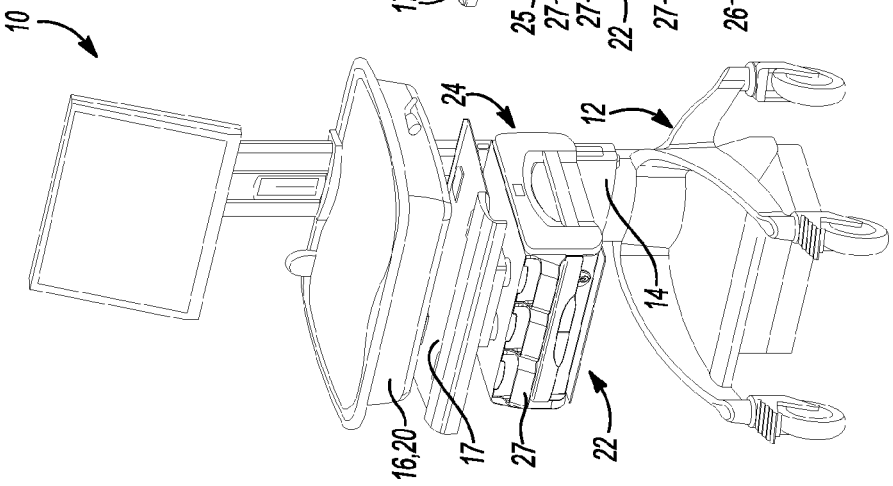


Fig-1A

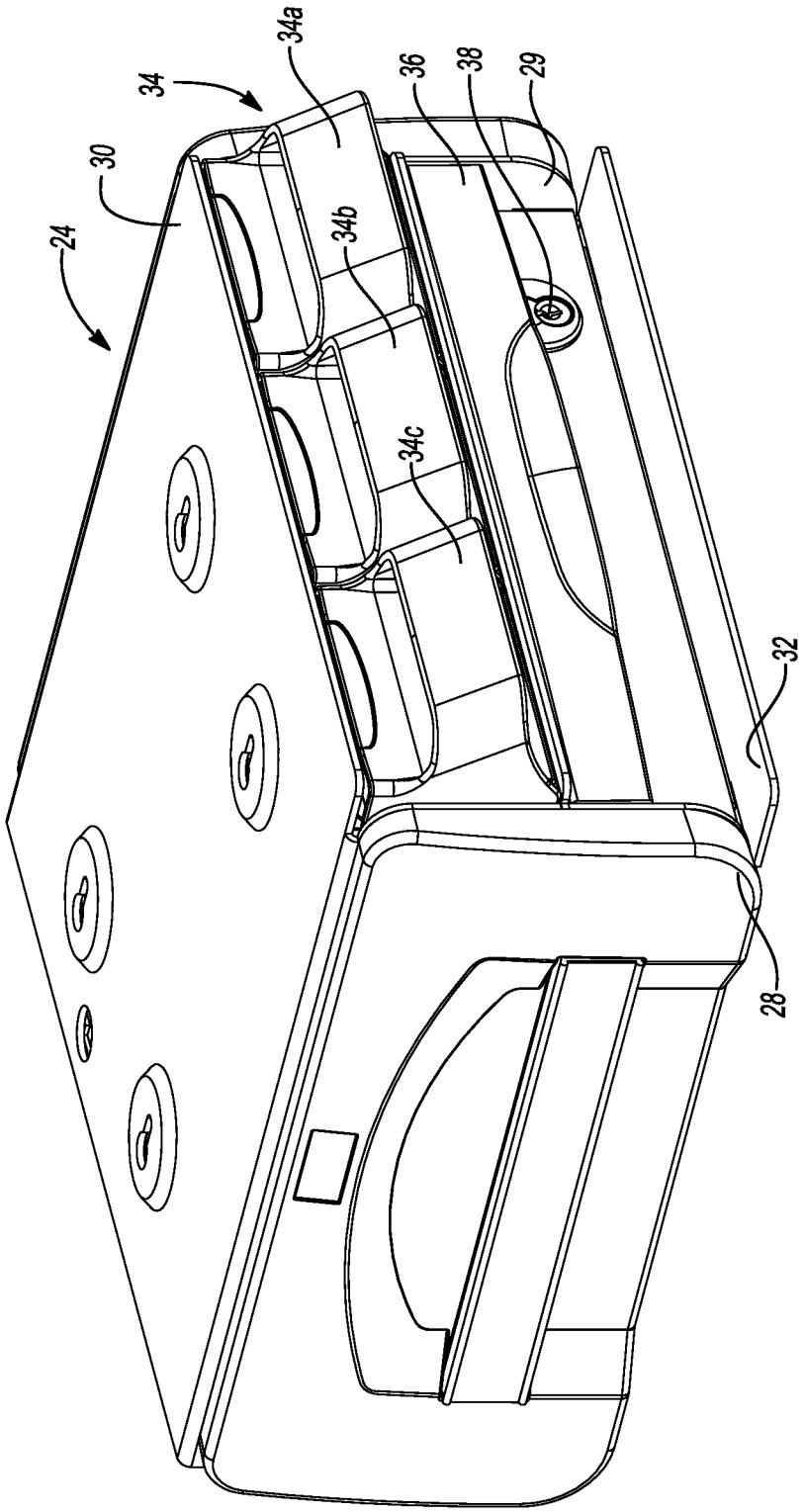


Fig-2

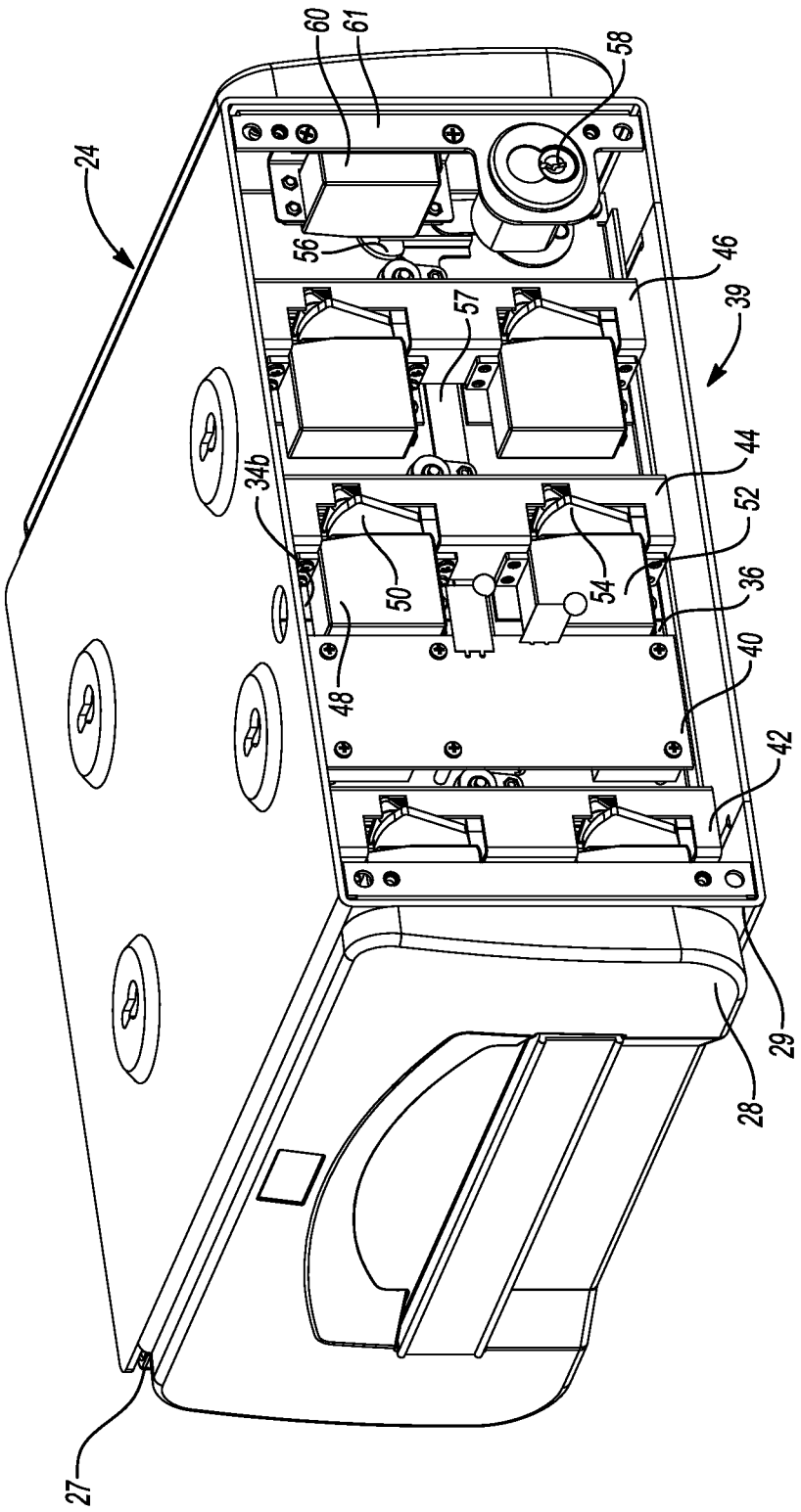


Fig-3A

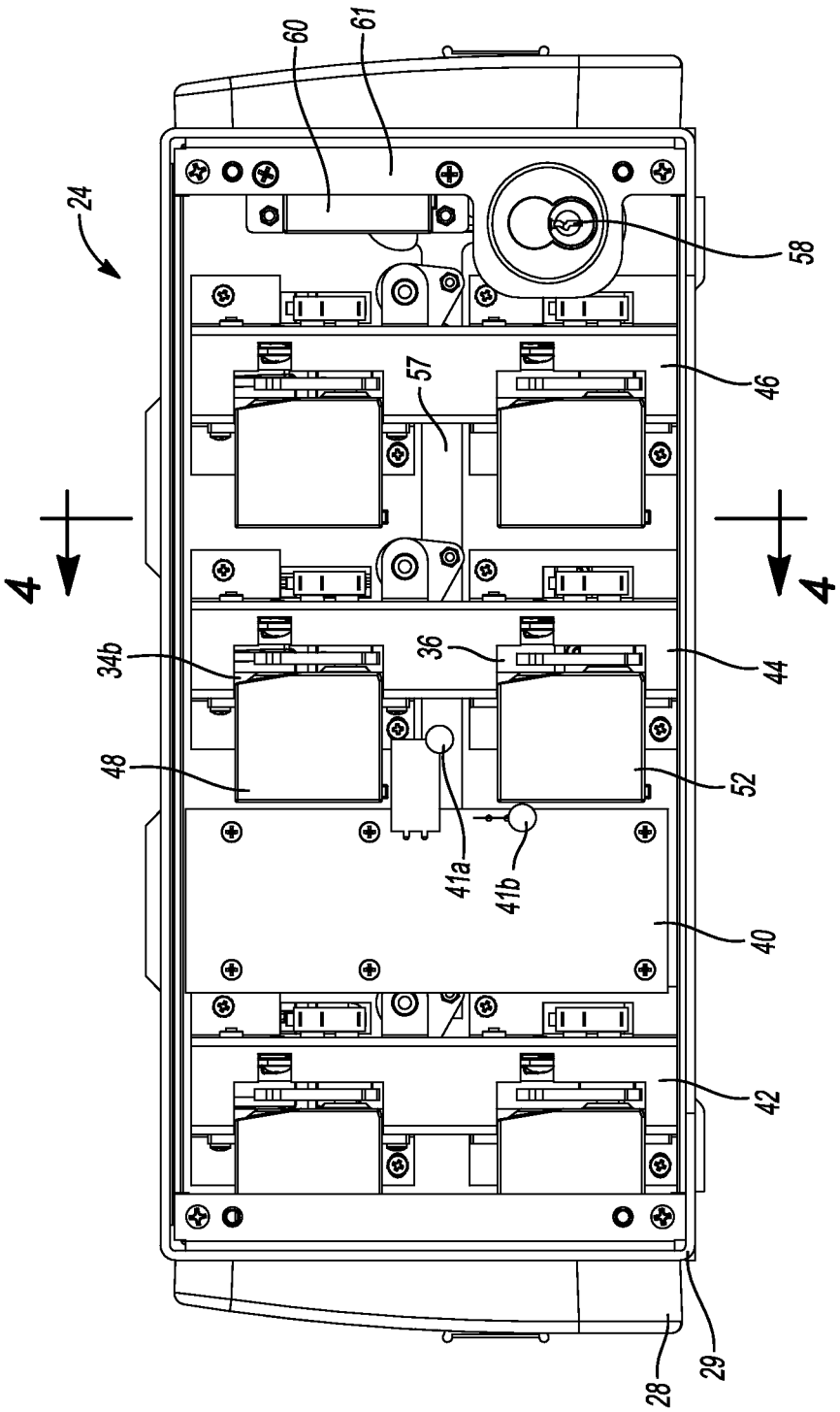


Fig-3B

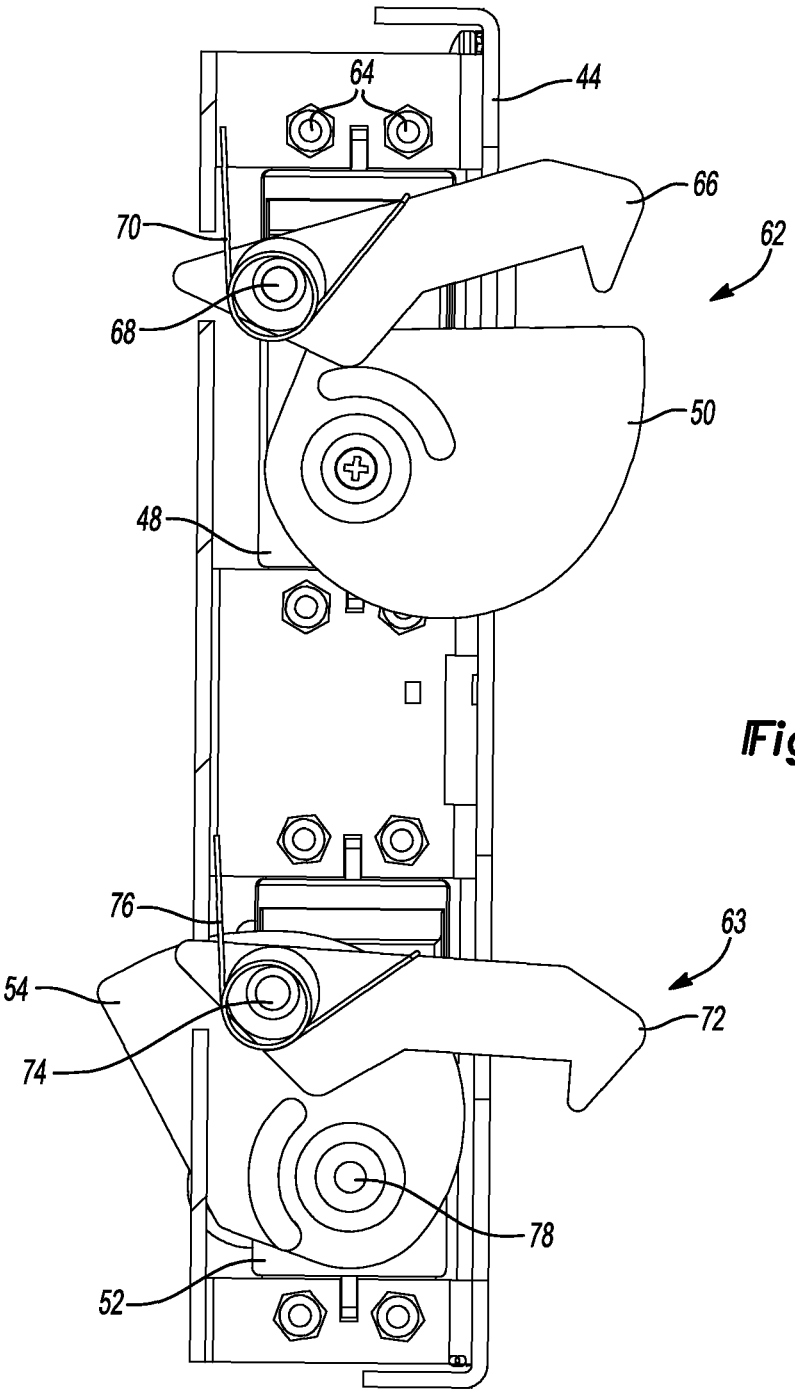
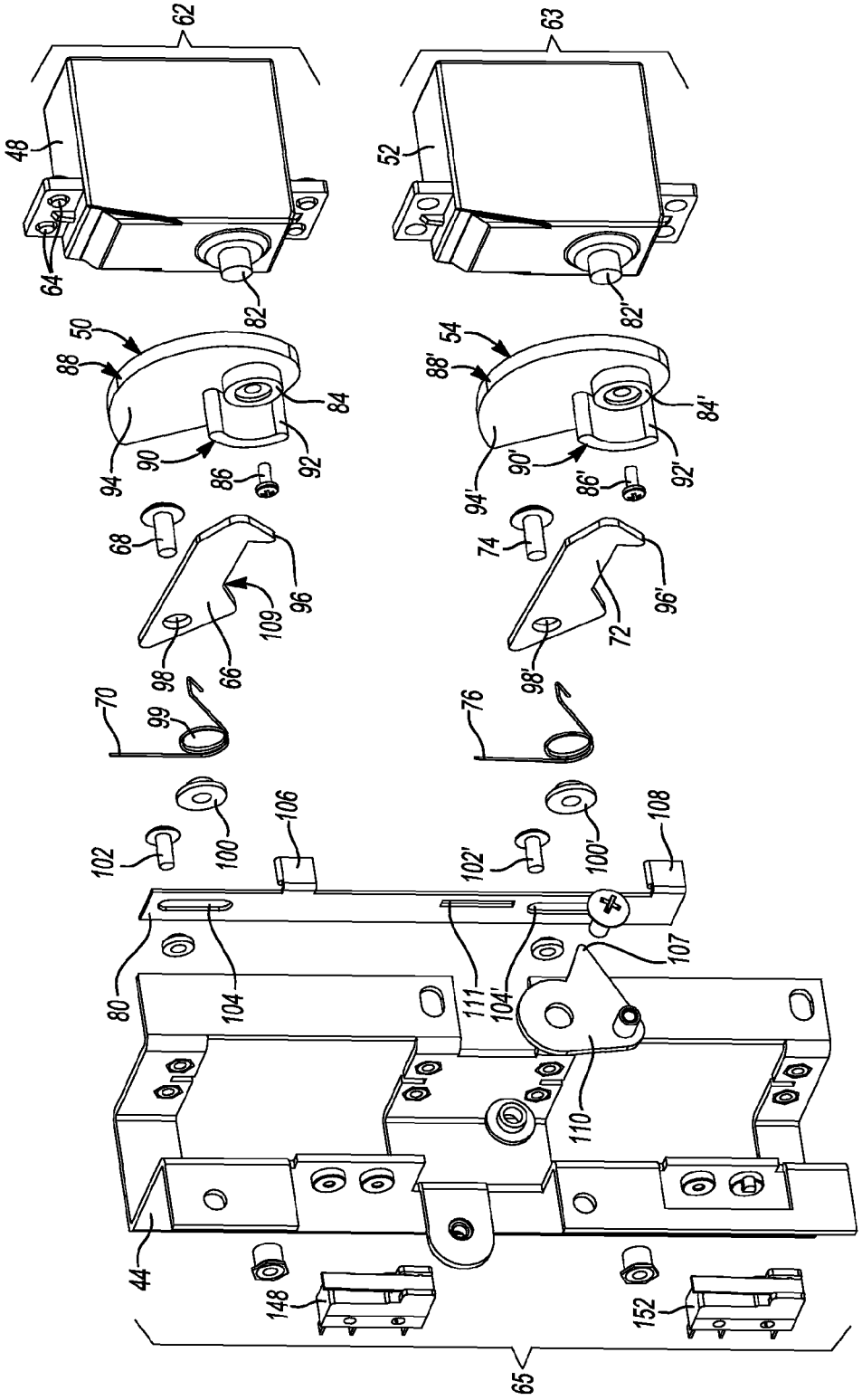


Fig-4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104'
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152
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Fig-5

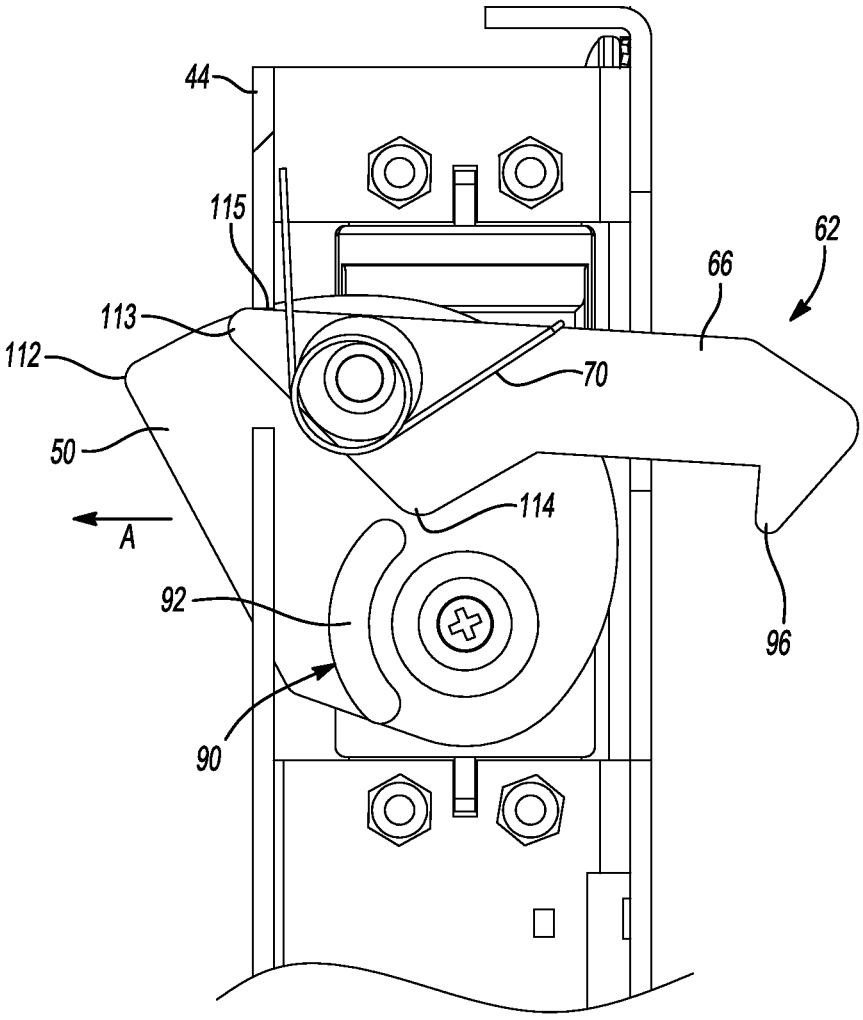

Fig-6

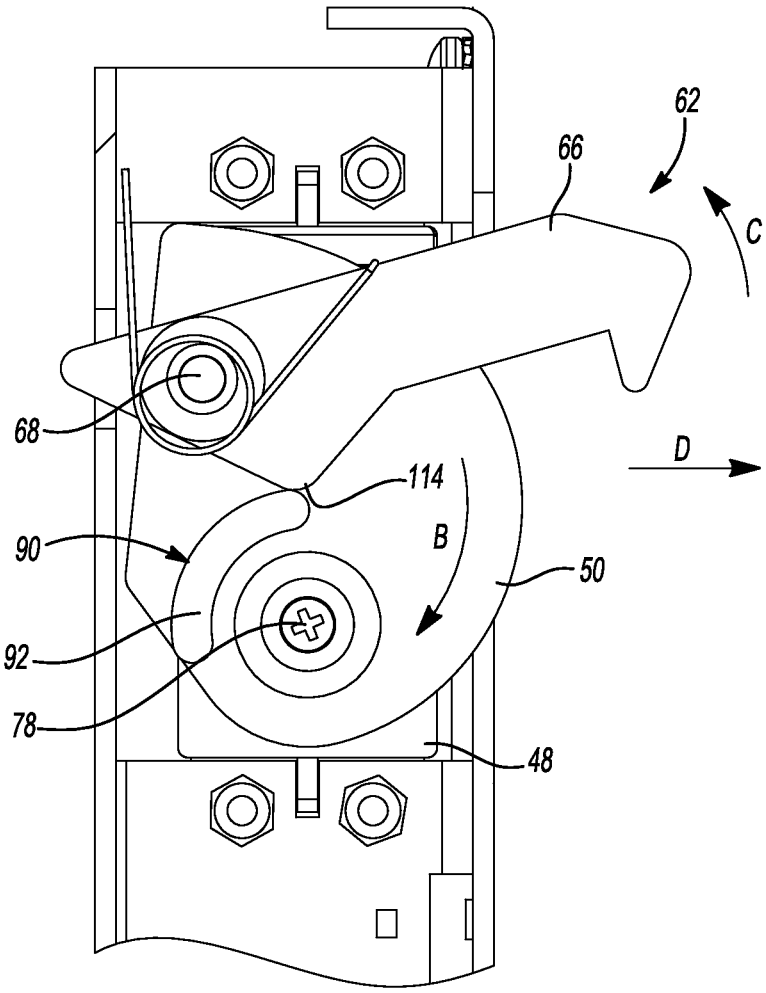

Fig-7

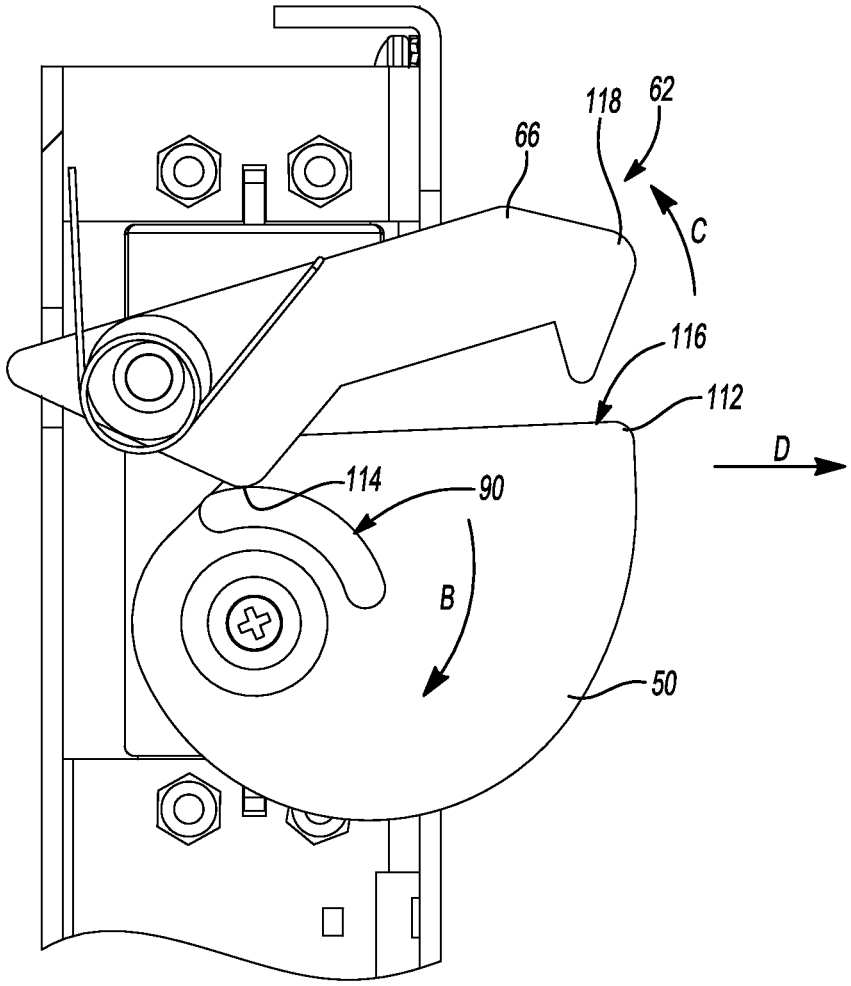

Fig-8

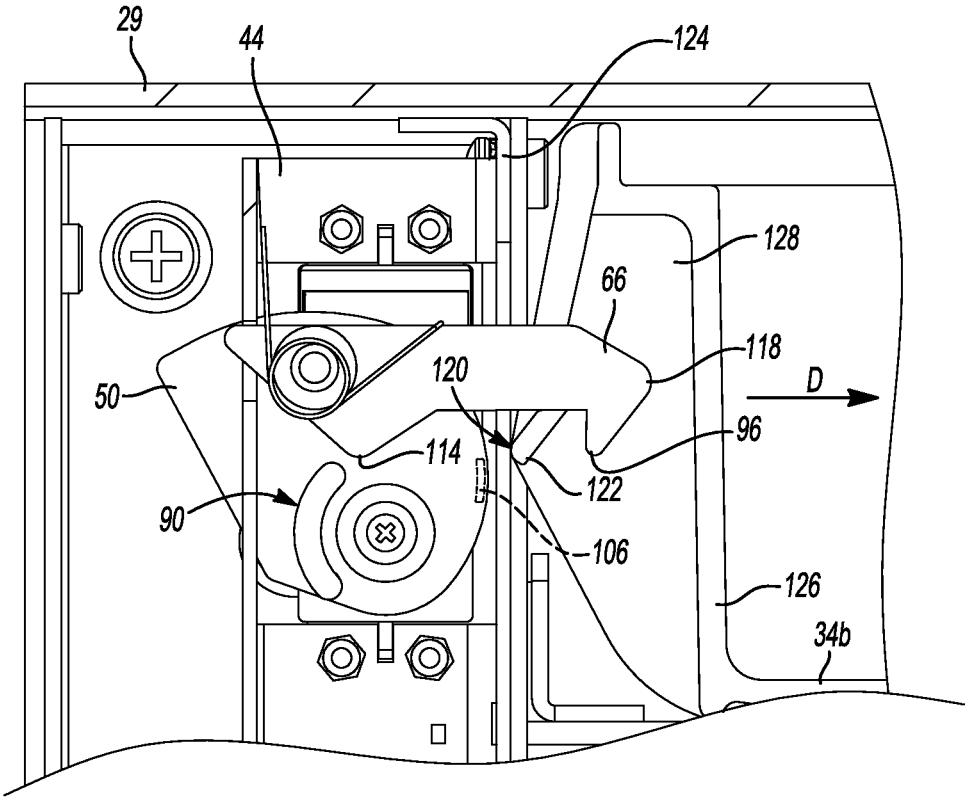

Fig-9

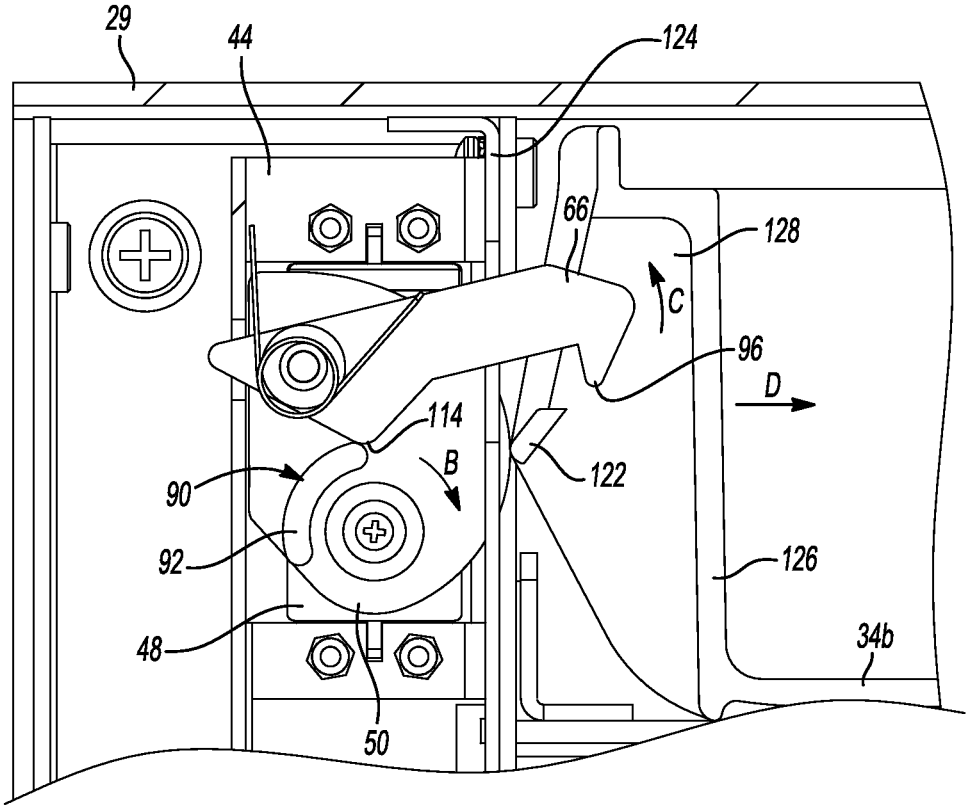

Fig-10

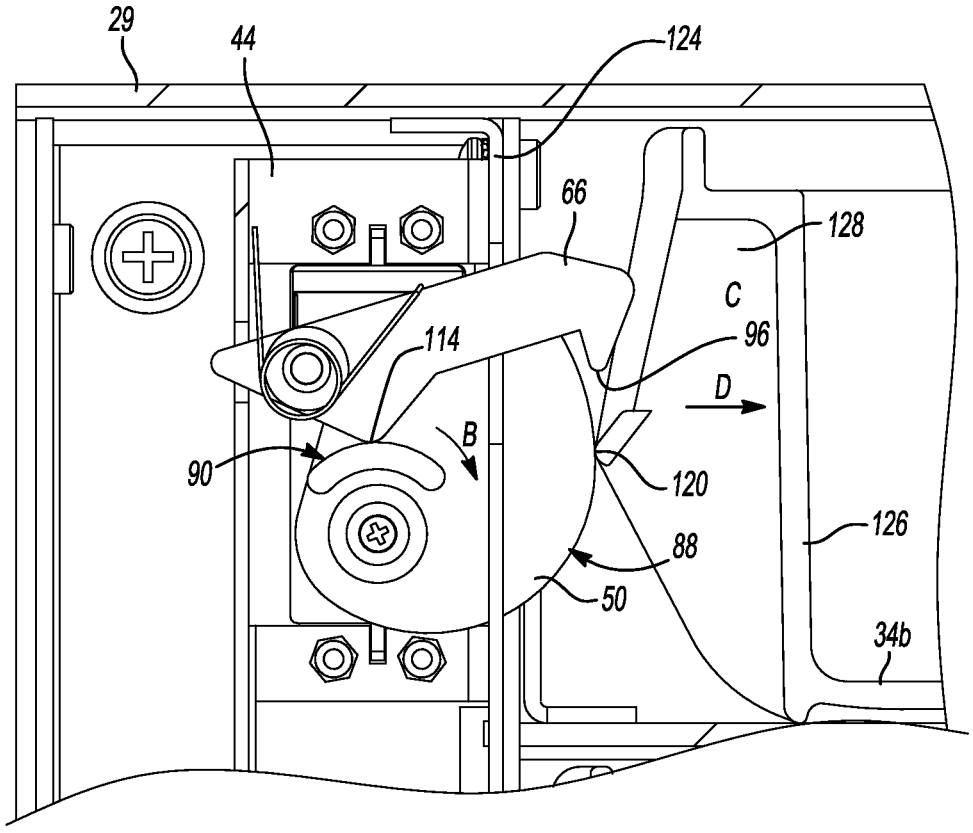

Fig-11

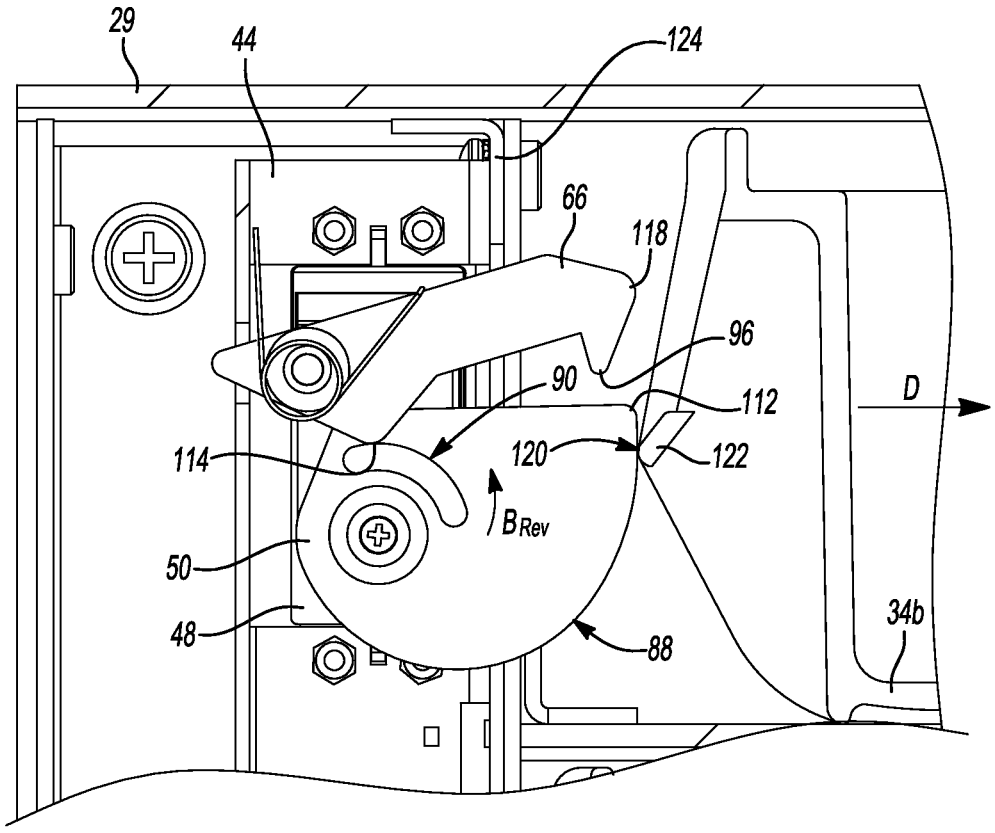

Fig-12

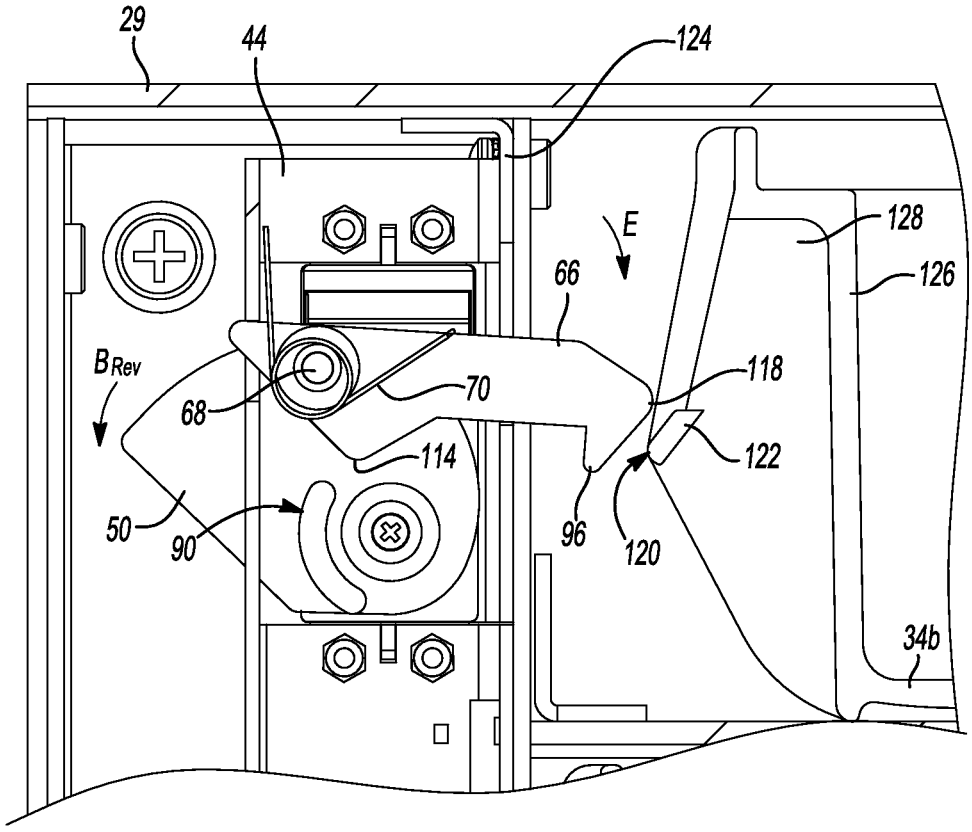

Fig-13

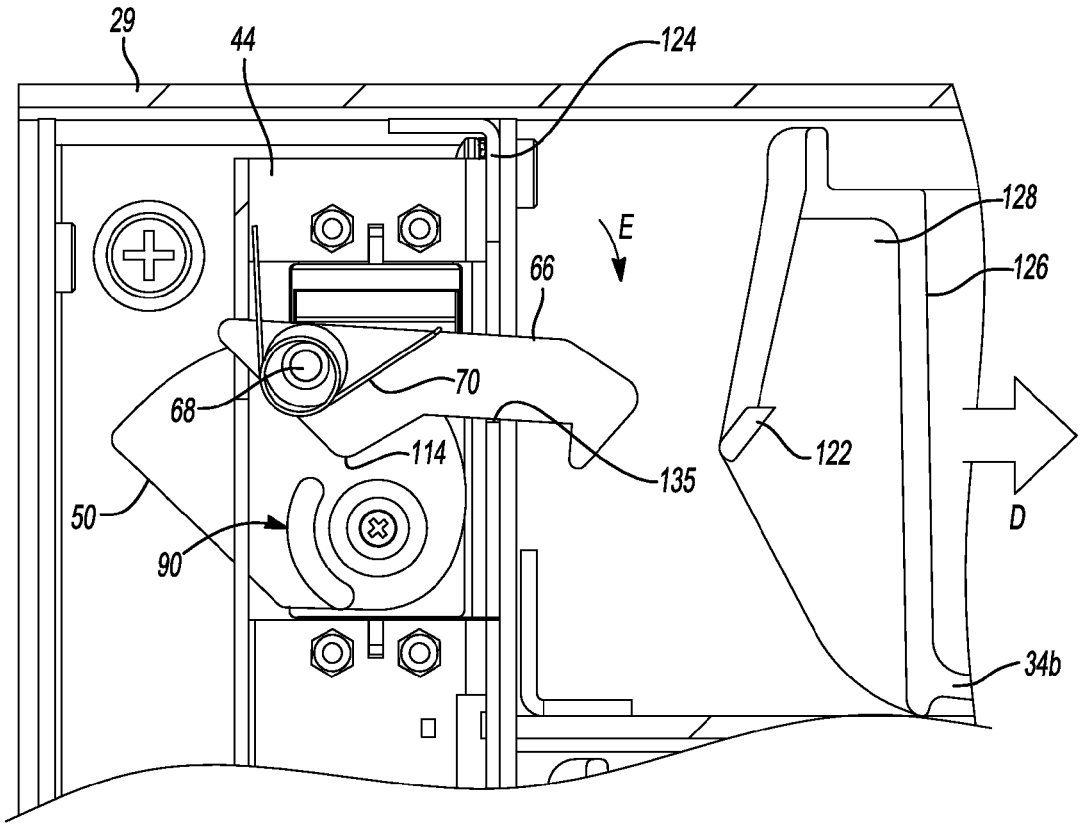

Fig-14

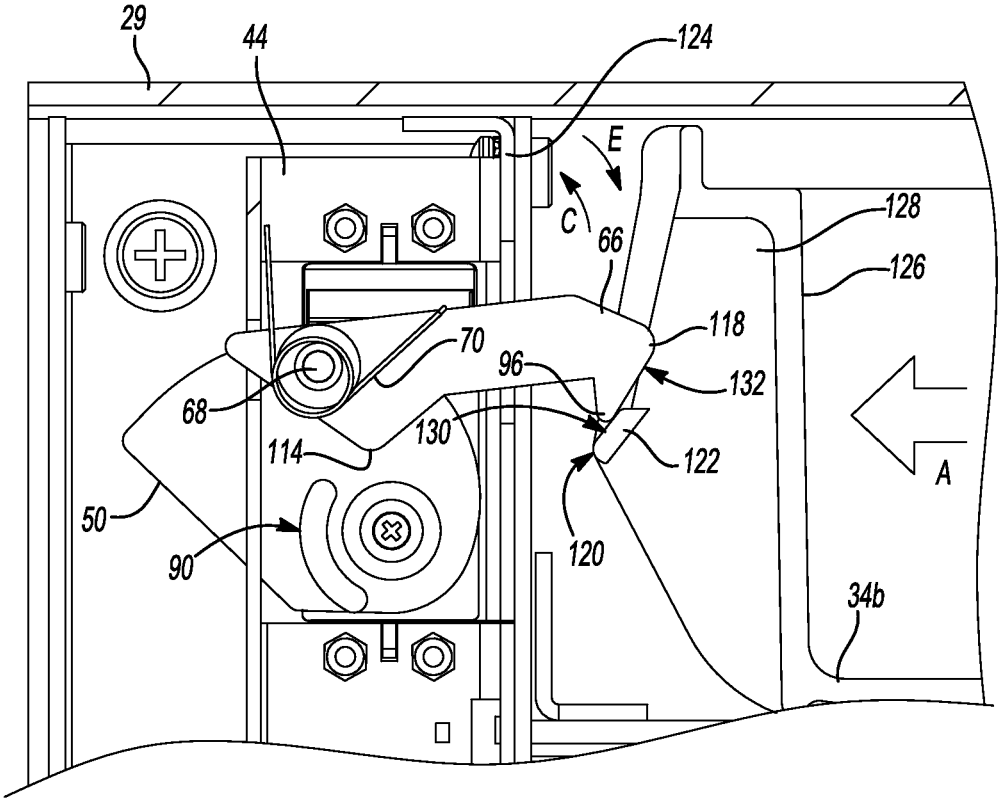

Fig-15

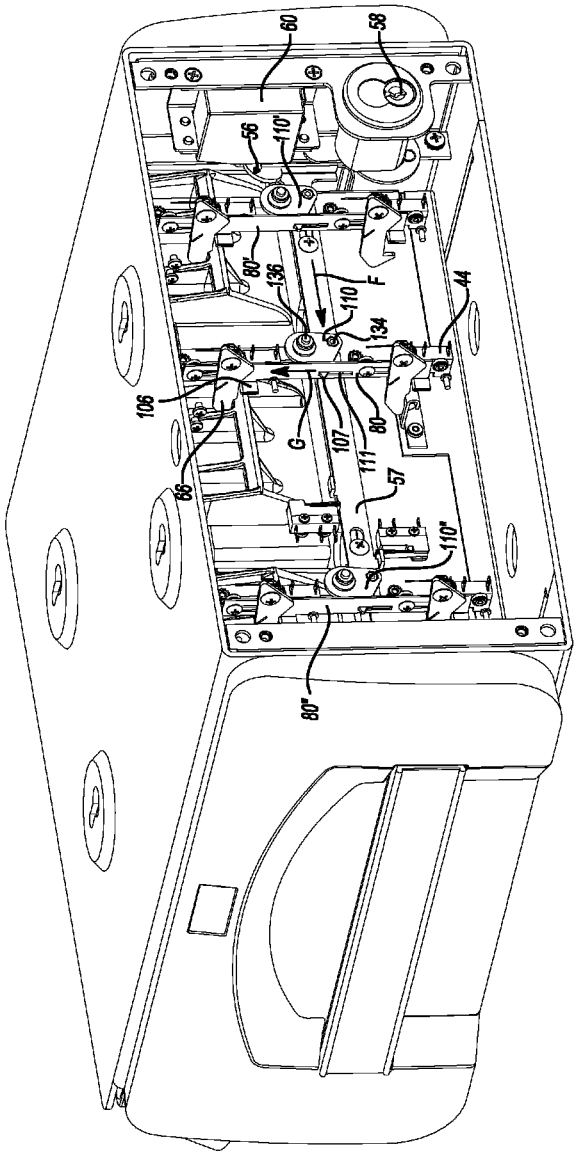

Fig-16

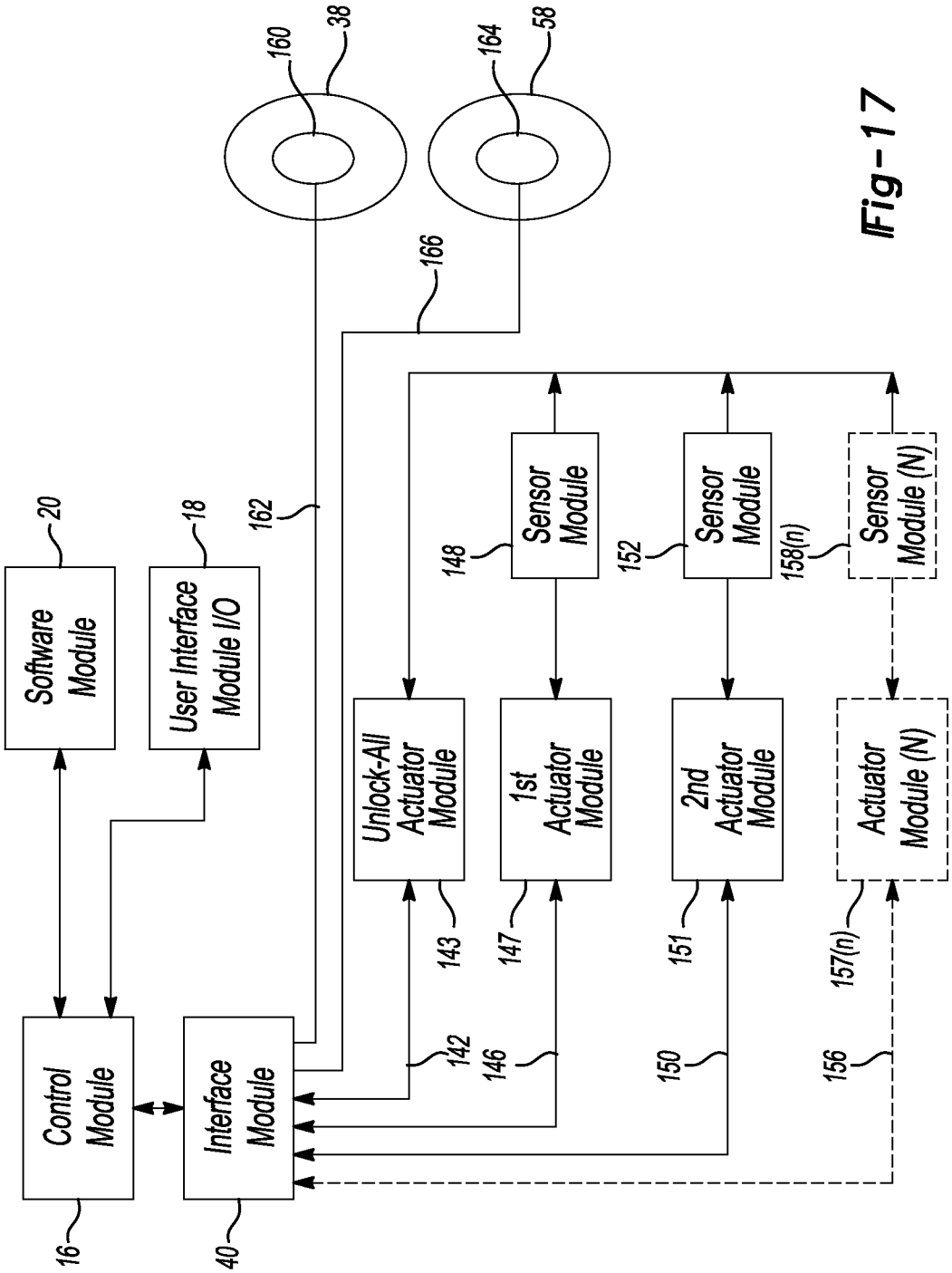
Control Module
16
Interface Module
40
Software Module
20
User Interface Module I/O
18
162
166
160
38
164
58
Unlock-All Actuator Module
143
142
1st Actuator Module
147
146
2nd Actuator Module
151
150
Actuator Module (N)
157(n)
156
Sensor Module
148
Sensor Module
152
Sensor Module (N)
158(n)

Fig-17

STORAGE DEVICE WITH LOCKING MECHANISM

This application is a National Stage of International Application No. PCT/US2011/062854, filed on Dec. 1, 2011, which claims the benefit of U.S. Provisional Application No. 61/419,511, filed on Dec. 3, 2010. The disclosures of the above priority applications are hereby incorporated by reference in their entirety.

FIELD

The present disclosure relates to a storage device having a locking mechanism for selectively locking or unlocking the storage compartments of the module and a system incorporating same.

BACKGROUND

This section provides background information related to the present disclosure which is not necessarily prior art.

Mobile storage assemblies and mobile computer workstations are well known in the art. Generally, in such mobile workstations, storage space may be provided in the form of shelves or drawers for storage of various work-related items. Additionally, to facilitate a computer and related components, an open, retractable keyboard shelf may be provided to store a computer keyboard when not in use.

U.S. Pat. No. 5,716,116 (Carlson et al.), which is assigned to the assignee of the subject invention and hereby incorporated by reference, discloses a modular storage and support structure that when fully assembled, forms a utility cabinet that can be swingingly secured to each lateral side of the assembly.

U.S. Pat. No. 5,803,559, which is assigned to the assignee of the subject invention and hereby incorporated by reference, discloses a lockable modular storage and support assembly utilizing a locking bar within a corrugated interior surface.

U.S. Pat. No. 5,805,075, which is assigned to the assignee of the subject invention and hereby incorporated by reference, discloses a modular storage and support assembly utilizing vertical support posts. An electronic control system controls a security system for locking and unlocking the modular storage and support assembly.

U.S. Pat. No. 6,158,830, which is assigned to the assignee of the subject invention and hereby incorporated by reference, discloses a lock assembly for use in an enclosed structure housing a locking bar having a plurality of locking fingers. Furthermore, disclosed is a lock arm mechanism having a lock arm and a lock arm mounting assembly for mounting the lock arm mechanism in the enclosed structure. The lock arm causes a rigid finger on the locking bar to be raised and lowered and in doing so raises and lowers the locking bar.

While the above modular storage and support assemblies have proven satisfactory for their purposes, further improvements in such assemblies are desired. What is needed is a modular storage assembly that provides improved locking and un-locking features.

SUMMARY

This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

According to several embodiments, a storage cabinet includes a housing with individual storage devices that may be moveable between a closed position and an opened position. Locking mechanisms associated with the storage devices may place the storage devices in a locked condition and an unlocked condition. The locking mechanisms include an actuator that drives a cam including a first cam surface and a second cam surface. A latch having a first cam follower surface may be driven by the first cam surface to an unlatched position. A biasing member biasing the latch toward the latched position and/or a sensor module detecting the condition of one of the storage device and latch may also be included.

In some embodiments, the storage devices may have an end wall separating a storage compartment and a locking mechanism engagement portion of the storage device. The locking mechanism engagement portion may include an end face, a retention member and a cavity formed intermediate the end wall and the end face. A first end of the latch may extend into the cavity and the latch may engage the retention member when in the locked condition. The end face of the storage device may have a second cam follower surface driven by the second cam surface to place the storage device in the opened position.

In addition, the storage cabinet may include a control module for managing the operation of the locking mechanism, and an interface module in communication with the actuator and the sensor module.

According to other embodiments, a storage device with a locking mechanism includes a housing having a frame assembly. A storage device is movably received in the housing. An actuator is connected to the frame assembly, the actuator operating to move a cam member. A latch is connected to the frame assembly and is moved by contact with the cam member from a latched position preventing access to the storage device in the housing to an unlatched position permitting access to the storage device. An unlock-all mechanism operating to move the latch to the unlatched position without operation of the actuator.

According to further embodiments, a storage device with a locking mechanism includes a housing having a frame assembly. A plurality of storage devices are individually movably received in the housing. A plurality of actuators are individually connected to the frame assembly. The actuators are individually connected to and operate to move individual cams or a plurality of cam members. A plurality of latches are individually connected to the frame assembly and are individually moved by contact with individual ones of the cam members from a latched position preventing access to any one of the storage devices in the housing, to an unlatched position permitting access to any one of the storage devices. An unlock-all mechanism operates when displaced to move the plurality of latches to the unlatched position without operation of any of the plurality of actuators. A control module communicates with the actuators via command inputs by an operator to activate (for example, energize or de-energize) one, some, or all of the actuators, or the unlock-all mechanism.

According to still other embodiments, a storage device with a locking system of the present disclosure includes multiple bins and/or drawers and provides for the capability to selectively unlock or unlatch any one, some or all of the bins and/or drawers, or collectively unlock all of the bins and drawers simultaneously.

Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

FIGS. **1**A-**1**C are front left elevational perspective views of 3 exemplary mobile workstations each having a storage device with a locking mechanism according to the present disclosure;

FIG. **2** is a front right perspective view of a storage device with a locking mechanism of FIG. **1**A;

FIG. **3**A is a left rear perspective view of the storage device of FIG. **2**;

FIG. **3**B is a rear elevational view of the storage device of FIG. **2**;

FIG. **4** is a partial cross sectional side elevational view taken at section **4** of FIG. **3**;

FIG. **5** is an exploded view of multiple sections of a locking mechanism according to the present disclosure;

FIG. **6** is a partial cross sectional side elevational view similar to FIG. **4** with the latch shown in a latched position;

FIG. **7** is a partial cross sectional side elevational view similar to FIG. **6** with the latch shown in an unlatched position and the cam proximate to a cam initial contact position;

FIG. **8** is a partial cross sectional side elevational view similar to FIG. **6** with the latch shown in an unlatched position and the cam in a cam final contact position;

FIG. **9** is a partial cross sectional side elevational view similar to FIG. **4** with the latch shown in a latched position engaging a retention member of a bin;

FIG. **10** is a partial cross sectional side elevational view modified from FIG. **9** to show the bin latch in an unlatched position disengaged from the retention member of the bin and the bin cam proximate to a cam initial contact position;

FIG. **11** is a partial cross sectional side elevational view modified from FIG. **10** to show the bin latch in an unlatched position disengaged from the retention member of the bin and the bin cam in a cam mid-contact position;

FIG. **12** is a partial cross sectional side elevational view modified from FIG. **11** to show the bin latch in an unlatched position disengaged from the retention member of the bin and the bin cam in a cam final-contact position displacing the bin to a forward release position;

FIG. **13** is a partial cross sectional side elevational view modified from FIG. **12** to show the bin latch in an unlatched position disengaged from the retention member of the bin and the bin cam returned to a cam initial position releasing the latch behind the forward displaced bin;

FIG. **14** is a partial cross sectional side elevational view showing a bin in a released position;

FIG. **15** is a partial cross sectional side elevational view modified from FIG. **13** to show re-latching of the bin;

FIG. **16** is a left rear perspective view of the storage module of FIG. **2** having components removed to more clearly depict the unlock-all mechanism and associated components; and

FIG. **17** is a diagrammatic view of a control and operating system for the storage device locking mechanisms of the present disclosure.

Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

Example embodiments will now be described more fully with reference to the accompanying drawings wherein with reference to FIG. **1**A, a mobile work station **10** includes a wheeled chassis **12** permitting transportation of the mobile workstation **10**. A vertical support column **14** extends upwardly from the wheeled chassis **12** and provides support for a plurality of items including a control module **16**, a user interface module input/output device, such as one or more keyboards **18**, which may be located on a keyboard tray **17**, on a display, or on a work surface, a UPC or similar data reading device **19**, a software module **20** providing software for operation of control module **16**, and a storage cabinet **22**. According to several embodiments, control module **16** and software module **20** can be incorporated in a general purpose computer, a preprogrammed hardware device, or the like.

According to several embodiments, storage cabinet **22** can include a plurality of storage modules such as first and second storage modules **24**, **26**. Alternately, as shown in FIGS. **1**B and **1**C, one or more than two storage modules **24**, **25**, **26** can be provided. Each storage module can include one or more and/or any combination of individual storage devices **27** such as individual bins, compartments, trays and/or drawers, etc. which are shown in greater detail in FIG. **2** and discussed further herein. The control module **16** using software in software module **20** manages a control operating system to enter data such as individual storage device pass-words or codes, user pass-words or other identification data, and the like, required to lock or unlock individual ones of the first or second storage modules **24**, **25**, **26** for access by users of mobile work station **10**. Depending on the type of material stored in the individual storage modules **24**, **25**, **26**, mobile work station **10** can also provide for locking or unlocking each or all of the individual modules, requiring for example an input code or a manual key in addition to the information received or transmitted by control module **16**.

Referring to FIG. **2**, each storage module, such as exemplary first storage module **24**, may include a housing **29** having an upper connection plate **30** and an opposite lower connection plate **32**. Upper and lower connection plates **30**, **32** can be used to mount or dismount housing **29** with respect to the mobile workstation **10** and/or to one or more other housings. As shown in FIG. **1**, each storage module can include a plurality of storage devices **27** including sliding and lockable bins, drawers, trays, compartments, etc. In the example shown in FIG. **2**, first storage module **24** provides a plurality of storage devices **27** which can include first, second, and third bins **34***a*, **34***b*, **34***c* which are positioned in a side-to-side configuration. The storage devices **27** can further include one or more sliding drawers **36** located either above or below the bins **34**. According to additional embodiments, the individual storage modules can include one or a plurality of storage devices **27**, combinations of storage devices such as all bins or all sliding drawers, or additional quantities of either the bins and/or drawers. The storage device design is therefore flexible for multiple configurations as is required, such as for those in FIGS. **1**A through **1**C.

At a forward facing end of the housing **29**, a first manual lock set **38** can be provided such that a key (not shown), tumbler or similar mechanical device can be used to manually lock or unlock a specific one of either the bins **34** or the drawer **36**. This can provide for example a redundant or secondary locking system to control access to specific items such as narcotic drugs which require both a first and a second locking system.

Referring to FIGS. **3**A and **3**B and again to FIG. **1**, a rear portion of first storage module **24** provides a locking mechanism assembly **39** which can be used to lock each of the bins **34** and/or drawer **36**, or unlock all or individual ones of the bins **34** and/or drawer **36**. Locking mechanism assembly **39**, according to several embodiments, can include an interface

module **40** which can operate the locking mechanism which will be described in greater detail herein. Interface module **40** is in communication with control module **16**. Interface module **40** can be a hard-wired device used to relay commands from control module **16**, or can in other embodiments include smart components linked together with control module **16** and software module **20** to control operation of locking mechanism assembly **39**. First and second sensors **41***a*, **41***b* can be provided with interface module **40**. First and second sensors **41***a*, **41***b* can be, for example, motion detectors or similar sensors providing input to control module **16** to identify when any one or all of the storage devices **27** such as the bins or drawers are moved.

As shown, locking mechanism assembly **39** can include one or more locking mechanisms having one or more frame assembles, for example first, second and third frame assemblies **42**, **44**, **46**. The frame assemblies mount a plurality of actuators which are shown, for example, as servo motors that, individually or in combination, are operable to establish the locked or unlocked conditions of the bins **34** or the drawer **36**. In addition to servo motors, the actuators can also be any type of device such as solenoid devices, stepper motors, air or pneumatic devices, magnetic devices, or the like used to establish the locked or unlocked conditions of the storage devices **27**. In an exemplary embodiment, a first servo motor **48** is provided for locking or unlocking bin **34***b*. First servo motor **48** is connected such as by fastening to second frame assembly **44** and rotates a first cam member **50**. First cam member **50** is directly rotated by operation of first servo motor **48**. A second servo motor **52** located beneath first servo motor **48** is operated to directly rotate a second cam member **54** which can be used to lock or unlock drawer **36**. Each of the servo motors are in communication with and receive operating signals via interface module **40** from control module **16**.

In addition to the individual bin and drawer locking control provided by the servo motors, locking mechanism assembly **39** can further include an unlock-all mechanism **56** with each of the first and second storage modules **24**, **26**, only a portion of which is shown in FIG. **3**. Unlock-all mechanism **56** is linked using a mechanism link **57** to each of the first, second and third frame assemblies **42**, **44**, **46** such that unlock-all mechanism **56** can override the position of any of the servo motors and cam members to position all of the bins **34** and/or sliding drawers **36** together in their unlocked conditions. Unlock-all mechanism **56** includes a second manual lock set **58** manually operated by a key (not shown) or similar mechanical operator, and an unlock-all servo motor **60**, either of which can be used to operate unlock-all mechanism **56** to vertically displace mechanism link **57**. Unlock-all servo motor **60** can be operated using control module **16**, or if electrical power is not available or as desired by the user, manual lock set **58** can be used as an override or backup. Unlock-all mechanism **56**, second manual lock set **58**, and unlock-all servo motor **60** are all connected to and supported by a frame assembly **61** which is also connected to housing **29**.

Referring to FIG. **4**, independent first and second servo subsystems **62**, **63** each having a servo motor, a cam member, and a latch are shown. Each of first and second servo subsystems **62**, **63** are connected in this example to second frame assembly **44**, however, according to further embodiments only one of a first or second servo subsystem may be connected to any of the frame assemblies. Fasteners **64** such as threaded fasteners or rivets are used to mount the individual servo motors such as first servo motor **48** to the frame assemblies, such as second frame assembly **44**. Individual latches are rotatably displaced by operation of the servo motors which in turn cause rotation of the cam members which directly contact the latches to move the latches from a latched to an unlatched position. In the example shown a bin latch **66** is positioned in the unlatched position and a drawer latch **72** is positioned in a latched position. In this embodiment, bin latch **66** is rotatably connected using a latch pin **68** to second frame assembly **44**. A latch biasing member **70** such as a spring is provided for each latch to normally bias the latch to a latched position, which is oriented substantially horizontal as shown for drawer latch **72**. Bin latch **66** in the unlatched or upwardly rotated position is achieved by operating first servo motor **48** which directly rotates first cam member **50** to rotate bin latch **66** against the biasing force of latch biasing member **70**. Drawer latch **72** is rotatably connected to second frame assembly **44** and is held in the latched position by the biasing force of a latch biasing member **76**. Second cam member **54** is shown positioned in an initial cam position which permits latch biasing member **76** to retain drawer latch **72** in the latched position. Each of the cam members are fixed to one of the servo motors using a cam attachment fastener **78**.

With continuing reference to both FIGS. **3**A, **3**B, **4** and **5**, each of the frame assemblies includes an unlock-all link such as unlock-all link **80** shown, which is slidingly connected and can be displaced upwardly to rotate all of the latches connected to that frame assembly from the latched to the unlatched position. In the example shown, unlock-all link **80** is slidingly connected to second frame assembly **44** and is shown in a normally downward or disengaged position, which allows the individual servo motors to be operated to control individual ones of the latches.

With continuing reference to FIGS. **1** through **5**, each additional bin such as bin **34***a*, **34***c* and/or each additional drawer **36***n* for each of first and second storage modules **24**, **26** (or additional storage modules if present) will include a servo motor, cam member and latch to permit individual locking and unlocking of the bin, drawer, tray, compartment, etc. Control commands for the servo motors are similarly fed through interface module **40** from control module **16** such that the user can control the locking and/or unlocking of any individual bin, drawer, tray, compartment, etc. from mobile workstation **10**, or control the simultaneous unlocking of all the storage devices of workstation **10**.

Referring to FIG. **5**, individual components of first and second servo sub-systems **62**, **63** and a frame portion **65** of the unlock-all mechanism are depicted. The following discussion of first servo sub-system **62** therefore applies to any servo sub-system. The servo motor **48** includes a drive shaft **82** which is received in a cam bearing member **84** of the individual cam members. A fastener **86** contacting the cam bearing member **84** and received in the drive shaft **82** connects the cam member to the drive shaft **82**. Each cam member further includes a curved first cam surface **88** and a curved second cam surface **90**. Second cam surface **90** is created on a cam extension **92** which extends perpendicular to a cam body **94**. First cam surface **88** is the curved perimeter edge portion of cam body **94**.

With continuing reference to both FIGS. **4** and **5**, each of the latches includes a latch hook **96** at a first end and a through aperture **98** at a second end. Through aperture **98** receives latch pin **68**. The latch pin **68** is also slidably received through a coil portion **99** of latch biasing member **70** to retain the position of the latch biasing member **70** with respect to latch **66**. A latch nut **100** retains the latch biasing member **70** and latch **66** in position with respect to the individual frame assemblies.

With continuing reference to FIGS. **3**A, **3**B, **4** and **5**, frame portion **65** includes unlock-all link **80** of frame assembly **44**

which is slidably connected to frame assembly **44** using two link retaining fasteners **102**, **102'** individually received in elongated slots **104**, **104'** which allow unlock-all link **80** to slide upwardly and downwardly with respect to frame assembly **44**. Unlock-all link **80** further includes a first and a second latch displacement arm **106**, **108** which are both oriented perpendicular to unlock-all link **80**. Each are positioned to contact a bottom latch face **109** of latch **66** and latch **72** such that a vertical upward sliding displacement of unlock-all link **80** causes the first and second latch displacement arms **106**, **108** to co-rotate the latches from the latched to the unlatched position. An unlock-all cam **110** is rotatably connected to unlock-all frame assembly **62** and to each of the other frame assemblies. The mechanism link **57** is rotatably connected to each unlock-all cam **110** such that a horizontal displacement of mechanism link **57** rotates the unlock-all cams **110**. An extending arm **107** of the unlock-all cams is received in an elongated slot **111** of each of the unlock-all links **80**. Rotation of the unlock-all cams **110** causes the extending arm **107** to vertically displace the unlock-all links **80**. The unlock-all cams **110** therefore translate a horizontal displacement motion of mechanism link **57** into a vertical displacement motion which vertically displaces each unlock-all link to move the latches to their unlatched positions.

As further seen in FIG. **5**, first and second sensor modules **148**, **152** can also be connected to any of the frame assemblies, including in the exemplary embodiment shown to second frame assembly **44**. Sensor modules can provide signals indicative of the latched/unlatched condition and/or locked/unlocked condition and/or closed/opened condition of the storage devices. According to several embodiments, first and second sensor modules **148**, **152** can be switches such as on-off switches shown. For example, first and second sensor modules **148**, **152** individually provide a signal indicating either a storage device locked (closed) position direct contact with the bin or drawer, or a storage device unlocked (open) position when the bin or drawer is not in contact with the switch. Other suitable sensor modules can include proximity sensors, Hall effect sensors, vane sensors, photoelectric sensors, snap-action switches and piezoelectric sensors, to name a few.

The following discussion of FIGS. **6** through **15** is related only to first servo sub-system **62**, however, it is noted that the description of first servo sub-system **62** applies equally to second servo sub-system **63**. Therefore a discussion of second servo sub-system **63** and other servo sub-systems to lock and/or unlock any other storage device of the present disclosure is not provided.

With reference to FIG. **6** and again to FIG. **4**, first servo sub-system **62** is shown having bin latch **66** in the latched position and first cam member **50** in the initial cam position. In the initial cam position, a cam maximum extension portion **112** and a second end **113** of bin latch **66** both extend in a rear direction "A" with respect to frame assembly **44**. A cam follower **114** of bin latch **66** is directed downwardly, similar to latch hook **96**. Also in the initial cam position, the cam follower **114** is freely spaced from the second cam surface **90** of cam extension **92**. Second end **113** of bin latch **66** extends rearwardly and partially beyond frame assembly **44**, and is in contact with an aperture wall **115** of frame assembly **44** which together with the biasing force of latch biasing member **70** holds bin latch **66** in the latched position shown. Latch biasing member **70** maintains contact pressure with bin latch **66** to hold bin latch **66** in the latched position until cam follower **114** is contacted by the second cam surface **90** during subsequent rotation of first cam member **50**.

Referring to FIG. **7** and again to FIG. **6**, bin latch **66** is shown after rotated displacement to its unlatched position. This is achieved by operation of servo motor **48** which directly rotates first cam member **50** in a cam rotation direction "B" which is a clockwise rotation as viewed in FIG. **7**. As first cam member **50** rotates with respect to a longitudinal axis defined by cam attachment fastener **78**, the second cam surface **90** of cam extension **92** contacts cam follower **114**. Because bin latch **66** is rotatably connected by latch pin **68**, contact with cam follower **114** causes an oppositely directed rotation of bin latch **66** about a latch open rotation direction "C", which is a counterclockwise rotation as viewed in FIG. **7**. Rotation in the latch open rotation direction "C" works against the biasing force of latch biasing member **70** to compress latch biasing member **70**. Bin latch **66** will remain in the unlatched position as long as contact between cam follower **114** and second cam surface **90** is maintained. In the exemplary embodiment shown in FIG. **7**, second cam surface **90** has approximately 90 degrees of arc, therefore contact between cam follower **114** and second cam surface **90** will be maintained for approximately 90 degrees of rotation of first cam member **50**. A different desired rotational arc can be provided by changing the degree of arc for second cam surface **90**.

Referring to FIG. **8**, continued rotation of first cam member **50** in the cam rotation direction "B" has resulted in a cam planar face **116** being oriented substantially horizontal and facing upward as shown. In this position, contact is still present between second cam surface **90** and cam follower **114**, therefore bin latch **66** is maintained in the unlatched position. Also in this cam rotated position, cam maximum extension portion **112** of first cam member **50** is directed to a maximum extent in a forward direction "D", which positions cam maximum extension portion **112** forward of a latch first end **118**.

Referring to FIG. **9**, the latched position of bin latch **66** retains bin **34***b* in a locked condition. Bin **34***b* has a bin end face **120**. Bin **34***b* further includes a bin retention member **122** positioned proximate bin end face **120**. Latch hook **96** of bin latch **66** is positioned forward of bin retention member **122** such that bin **34***b* cannot be displaced in the forward direction "D" for access from outside the housing **29**. Also in the bin locked position, bin end face **120** contacts a forward facing plate **124** of second frame assembly **44**. Space for receipt of latch hook **96** and latch first end **118** is provided between the bin end face **120** and an end wall **126** of bin **34***b* by provision of a hook clearance cavity **128** of bin **34***b* and drawer **36** respectively.

With continuing reference to FIG. **9** and FIGS. **5** and **7**, the normal positions of first and second latch displacement arms **106**, **108** are shown. As previously described, from these normal positions, vertical upward displacement of first and second latch displacement arms **106**, **108** will rotate bin latch **66** from the latched position shown to the unlatched position shown in FIG. **7** without rotation of first cam member **50**, therefore over-riding servo motor **48**.

Referring to FIG. **10**, first servo motor **48** is operated to begin rotation of first cam member **50**. By rotating first cam member **50** in the cam rotation direction "B", second cam surface **90** contacts cam follower **114** and bin latch **66** is rotated in the latch open rotation direction "C" such that latch hook **96** moves upwardly and away from engagement with bin retention member **122**. When first cam member **50** is in this transient position bin **34***b* can be manually pulled in the forward direction "D" to access its contents.

Referring to FIG. **11**, a further feature of the cam members of the present disclosure is evident. By continuing operation

of first servo motor **48** to continue rotation of first cam member **50** in the cam rotation direction "B", the first cam surface **88** also extends in the forward direction "D". This forward extension of first cam surface **88** contacts bin end face **120** and begins to automatically push bin **34***b* in the forward direction "D".

Referring to FIG. **12** and again to FIG. **8**, the cam maximum extension portion **112** of first cam member **50** when oriented to the maximum extent in forward direction "D" positions the cam maximum extension portion **112** forward of latch first end **118**. In this position bin **34***b* is automatically pushed in the forward direction "D" to the bin unlocked condition. Upon reaching this rotated position of first cam member **50**, first servo motor **48** then reverses rotation such that first cam member **50** is rotated in a cam reverse rotation direction "BRev", which subsequently releases bin latch **66**. Because bin **34***b* has been moved in the forward direction "D" by first cam member **50**, the latch hook **96** will not re-engage bin retention member **122** when it rotates downward to the latched position.

Referring to FIG. **13** and again to FIG. **12**, first servo motor **48**, either by continuous operation or following a dwell period, has rotated first cam member **50** in cam reverse rotation direction "BRev" substantially back to its initial cam position. In this position bin latch **66** is biased to return to its latched position by rotation in a latch engagement rotation direction "E". Bin **34***b* in the unlocked position cannot be re-engaged by latch hook **96** because latch hook **96** cannot re-enter hook clearance cavity **128** in this condition. Bin **34***b* is therefore free to be manually moved by a user in the forward direction "D" to access its contents.

Referring to FIG. **14** and again to FIG. **13**, bin **34***b* in the unlocked position can be manually withdrawn in the forward direction "D" to access and remove contents of bin **34***b*. The other bins, drawers, trays, compartments, etc. defining the storage devices can be manually withdrawn in the same manner when in the unlocked position. In the unlocked position of bin **34***b*, bin latch **66** is biased by biasing member **70** into contact with an aperture wall **135** of forward facing plate **128** of second frame assembly **44** to stop further rotation of bin latch **66** in the latch engagement rotation direction "E".

Referring to FIG. **15**, to re-engage bin **34***b* in the locked position, the user can manually push bin **34***b* in the rear direction "A" until a tapered face **130** of bin retention member **122** contacts a tapered face **132** of latch first end **118**. This camming action causes bin latch **66** to rotate in the latch open rotation direction "C" until latch hook **96** and latch first end **118** extend past bin retention member **122** and enter hook clearance cavity **128**. Bin latch **66** will thereafter rotate in the latch engagement rotation direction "E" due to the biasing force of latch biasing member **70** such that latch hook **96** once again engages bin retention member **122**.

Referring to FIG. **16** and again to FIGS. **3**B and **5**, operation of the unlock-all mechanism **56** is as follows. Operation of either unlock-all servo motor **60** or second manual lock set **58** horizontally translates mechanism link **57** in a displacement direction "F". Each of the unlock-all cams **110**, **110'**, **110"** are rotatably connected to the mechanism link **57** using first rotational fasteners **134** and are rotatably connected to structure of the frame assemblies such as second frame assembly **44** using a second rotational fastener **136** which is positioned off-center with respect to first rotational fasteners **134**. Horizontal displacement of the mechanism link **57** therefore rotates the unlock-all cams **110**, **110'**, **110"**, for example in a clockwise rotation as viewed in FIG. **16**. As the unlock-all cams rotate the extending arm **107** contacts an end wall of elongated slot **111** causing the unlock-all links **80**, **80'**, **80"** to displace vertically upward, in a vertical displacement direction "G". This displacement causes the first and a second latch displacement arms **106**, **108** of unlock-all links **80**, **80'**, **80"** to rotate all of the latches such as bin latch **66** toward their unlatched positions.

Referring to FIG. **17**, and again to FIG. **1**, the schematic representation of a control and operating system for the storage device and locking mechanisms of the present disclosure shows a control module **16** is in communication with software module **20**. Commands and feedback signals to/from unlock-all actuator module **143** are provided via a control line **142** between unlock-all actuator module **143** and an interface module **40**. Commands and feedback signals between interface module **40** and a first actuator module **147** are provided via a control line **146**. A sensor module **148**, such as a bin position sensing device, can provide signals indicative of the latched/unlatched condition and/or locked/unlocked condition of the storage devices. Signals from the sensor module **148** can be carried via control line **146**. Commands and feedback signals between interface module **40** and a second actuator module **151** are provided via a control line **150**. A second sensor module **152**, such as a drawer position sensing device, can be provided together with second servo motor **52** whose signals can be carried via control line **150**. Similarly, commands and feedback signals between interface module **40** and any additional actuator modules **157**(*n*) are provided via additional control line(s) **156**(*n*). Correspondingly, additional sensor modules **158**(*n*) can be provided for each additional actuator module whose signal can also be carried via additional control line(s) **156**(*n*). The several sensor modules **148**, **152**, **158**(*n*) can also provide signals to unlock-all actuator module **143** via control line **144**, or alternatively, such signals can be provided to unlock-all actuator module **143** via the interface module **40**.

A first lock position sensor **160** can be provided with first manual lock set **38** to provide feedback to control module **16** via interface module **40** of the lock/unlock position of first manual lock set **38**. The signal from first lock position sensor **160** is carried via a data transfer line **162**. Similarly, a second lock position sensor **164** can be provided with second manual lock set **58** to provide feedback to control module **16** via interface module **40** of the lock/unlock position of second manual lock set **58**. The signal for second lock position sensor **164** is carried via a data transfer line **166**.

Example embodiments are provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting. As used herein, the singular forms "a," "an," and "the" may be intended to include the plural forms as well, unless the context clearly indicates otherwise. The terms "comprises," "comprising," "including," and "having," are inclusive and therefore specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. The method steps, pro-

cesses, and operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance. It is also to be understood that additional or alternative steps may be employed.

As described, the term module can include an application specific integrated circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group) and memory that execute one or more software or firmware programs, a combinational logic circuit, and/or other suitable components that provide the described functionality.

When an element or layer is referred to as being "on," "engaged to," "connected to," or "coupled to" another element or layer, it may be directly on, engaged, connected or coupled to the other element or layer, or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly on," "directly engaged to," "directly connected to," or "directly coupled to" another element or layer, there may be no intervening elements or layers present. Other words used to describe the relationship between elements should be interpreted in a like fashion (e.g., "between" versus "directly between," "adjacent" versus "directly adjacent," etc.). As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

Although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer or section. Terms such as "first," "second," and other numerical terms when used herein do not imply a sequence or order unless clearly indicated by the context. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the example embodiments.

Spatially relative terms, such as "inner," "outer," "beneath," "below," "lower," "above," "upper," and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the Figures. Spatially relative terms may be intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the Figures. For example, if the device in the Figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the example term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

What is claimed is:

1. A storage cabinet comprising:

a housing;

a plurality of storage devices included in the housing, each storage device being moveable between a closed position and an opened position;

a locking mechanism associated with each storage device, each locking mechanism operable to place the associated storage device in one of a locked condition and an unlocked condition, each locking mechanism comprising:

an actuator;

a first cam operably driven by the actuator, the first cam including a first cam surface and a second cam surface;

a latch comprising a first cam follower surface operably driven by the first cam surface to an unlatched position; and

a biasing member biasing the latch toward a latched position;

a sensor module detecting the condition of one of the storage device and latch;

each storage device comprising an end wall separating a storage compartment of the storage device and a locking mechanism engagement portion of the storage device, the locking mechanism engagement portion comprising:

an end face;

a retention member; and

a cavity formed intermediate the end wall and the end face;

wherein a first end of the latch extends into the cavity and the latch engages the retention member when in the locked condition; and

the end face of the storage device comprising a second cam follower surface operably driven by the second cam surface to place the storage device in the opened position.

2. The storage cabinet of claim **1**, wherein the locking mechanism further comprises an interface module, the interface module being in communication with the actuator and the sensor module.

3. The storage cabinet of claim **1**, further comprising a control module in communication with the interface module, the control module managing the operation of the locking mechanism.

4. The storage cabinet of claim **1**, wherein the locking mechanism further comprises at least one frame mounting at least one locking mechanism to the housing.

5. The storage cabinet of claim **1**, wherein the retention member comprises a second cam and the first end of the latch comprises a third cam follower surface operably driven by the second cam to move the latch in a direction toward the unlatched position when returning the storage device to a closed position.

6. The storage cabinet of claim **1**, wherein at least one of the locking mechanisms further comprises a manual override lock set.

7. The storage cabinet of claim **1**, further comprising a plurality of frames mounting the plurality of locking mechanisms to the housing.

8. The storage cabinet of claim **7**, further comprising an unlocking mechanism associated with all of the storage devices and operable to simultaneously place all of the plurality of storage devices in an unlocked condition.

9. The storage cabinet of claim **8**, wherein the unlocking mechanism comprises:

an actuator;

a first link operably connected to the actuator;

a plurality of unlocking cams pivotably attached to the first link and pivotally attached to the plurality of frames; and

a plurality of second links attached to the plurality of frames, each second link operably connected to a corresponding one of the plurality of unlocking cams, the second links comprising at least one extension portion engaging a corresponding latch of the locking mechanisms.

10. The storage cabinet of claim **8**, wherein the unlocking mechanism further comprises a manually operated lock set.

11. The storage cabinet of claim **1**, wherein the sensor module detects whether the latch is in one of the latched and unlatched positions.

12. A storage device having a locking mechanism, comprising:

a housing;

a plurality of storage devices received in the housing, each storage device moveable between a closed position and an opened position;

a plurality of locking mechanisms, each locking mechanism associated with one storage device of the plurality of storage devices and comprising:

a frame attached to the housing;

a first actuator connected to the frame and operable to move a first cam member;

a latch connected to the frame and moveable by contact with a respective first cam member from a latched position preventing access to the storage device in the housing to an unlatched position permitting access to the storage device in the housing; and

an unlock-all mechanism associated with all of the plurality of storage devices and operable to move each of the latches to the unlatched position without operation of any of the first actuators, the unlock-all mechanism comprising:

a first link;

a plurality of unlocking cams pivotably attached to the first link and pivotally attached to the frame; and

a plurality of second links attached to the frame, each second link operably connected to a corresponding one of the plurality of unlocking cams, the second links comprising at least one extension portion engaging a corresponding latch of the locking mechanisms, wherein the extension portion is spaced apart from a first rotational member about which the unlocking cam is pivotably attached to the frame and spaced apart from a second rotational member about which the unlocking cam is pivotably attached to the first link.

13. The storage device of claim **12**, further comprising a control module in communication with the actuator, the control module operating responsive to commands input by an operator to operate the actuator or to operate the unlock-all mechanism.

14. The storage device of claim **12** wherein the storage devices each comprise an end wall separating a storage compartment of the storage device and a locking mechanism engagement portion of the storage device, the locking mechanism engagement portion of the storage device comprising:

a end face;

a retention member; and

a cavity formed intermediate the end wall and the end face; and

wherein a first end of the latch extends into the cavity and the latch engages the retention member when in the latched position.

15. The storage device of claim **14** wherein:

the first cam member comprises a first cam surface and a second cam surface;

the latch comprises a first cam follower surface operably driven by the first cam surface to the unlatched position; and

the end face of the storage device comprises a second cam follower surface operably driven by the second cam surface to place the storage device in an opened position.

16. The storage device of claim **12** wherein:

the first cam member comprises a first cam surface;

the latch comprises a first cam follower surface operably driven by the first cam surface to the unlatched position; and

the locking mechanism further comprises a biasing member biasing the latch toward the latched position.

17. The storage device of claim **16** wherein:

the first cam member comprises a second cam surface; and

the storage device comprises a second cam follower surface operably driven by the second cam surface to place the storage device in an opened position.

18. The storage device of claim **12** further comprising a sensor module detecting the position of one of the storage device and latch.

19. The storage device of claim **12**, wherein the unlock-all mechanism comprises:

a second actuator operably connected to the first link;

wherein each unlocking cam includes an extension arm contacting the respective second link, the extension arm being spaced apart from the first rotational member about which the unlocking cam is pivotably attached to the frame and spaced apart from the second rotational member about which the unlocking cam is pivotably attached to the first link.

20. The storage device of claim **19**, wherein the unlock-all mechanism further comprises a manually operated lock set.

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